

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 031 764 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.08.2000 Bulletin 2000/35

(51) Int. Cl.⁷: F16H 55/56, F16H 9/24

(21) Application number: 00200530.4

(22) Date of filing: 17.02.2000

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 24.02.1999 BE 9900119

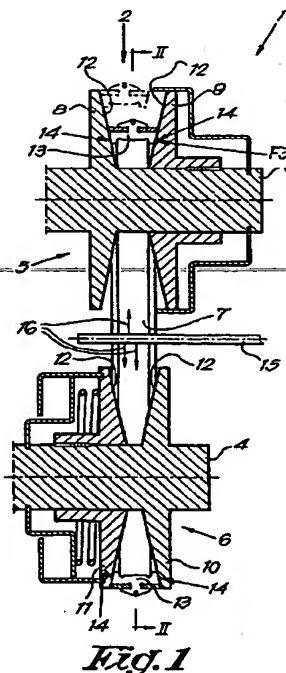
(71) Applicant:
ZF GETRIEBE N.V. SINT TRUIDEN
3800 Sint-Truiden (BE)

(72) Inventors:
• Adriaenssens, Frank Cornelius Maria
3060 Bertem (BE)
• Degeest, Dirk Geert Theo Dominique
3300 Tienen (BE)
• Broux, Jan Michel Maria
3520 Zonhoven (BE)
• Cops, Valentin Antoine
3590 Diepenbeek (BE)

(74) Representative: Donné, Eddy
Bureau M.F.J. Bockstael nv
Arenbergstraat 13
2000 Antwerpen (BE)

(54) **Transmission unit for motor vehicles, pulley used thereby and method for making such a pulley**

(57) Transmission unit for motor vehicles of the type containing a continuous variable transmission (2) consisting of an ingoing shaft (3), a driven shaft (4), two pulleys (5-6) situated on the ingoing shaft (3) and the driven shaft (4) respectively, and an endless transmission element (7) provided between said pulleys (5-6), whereby the above-mentioned pulleys (5-6) each consist of two pulley halves (8-9, 10-11) with conical contact surfaces (12) which can be axially adjusted in relation to one another, such that the transmission ratio between the ingoing shaft (3) and the driven shaft (4) can be continuously altered, whereby the transmission element (7) consists of a lubricated belt which is provided with metal parts (13) having contact surfaces (14) which work in conjunction with the above-mentioned conical contact surfaces (12) of the pulley halves (8-9, 10-11), and whereby the contact surfaces (14) of the parts (13) have a profiling (17), in particular a profiling (17) procuring a thin-film lubrication, characterized in that the conical contact surfaces (12) of the pulley halves (8-9, 10-11) concerned are polished.



EP 1 031 764 A1

Description

[0001] The present invention concerns a transmission unit for motor vehicles, a pulley used thereby, as well as a method for making such a pulley.

[0002] In particular, it concerns a transmission unit containing a continuous variable transmission, consisting of an ingoing shaft, a driven shaft, two pulleys situated on the ingoing shaft and the driven shaft respectively, and an endless transmission element provided between said pulleys, whereby the above-mentioned pulleys each consist of two pulley halves with conical contact surfaces which can be axially adjusted in relation to one another, such that the transmission ratio between the ingoing shaft and the driven shaft can be continuously altered.

[0003] It is known that with such a continuous variable transmission, it is possible to use a transmission element which consists of a lubricated belt which is provided with metal parts having contact surfaces which work in conjunction with the above-mentioned conical contact surfaces of the pulley halves. The metal parts are connected as such by means of flexible elements, such as cords or such.

[0004] The belt is lubricated by exposing the belt and/or the pulley halves to oil and/or a cooling liquid. This can be done in any way whatsoever. As described in European patent No. 0.574.085, this can be done for example by squirting the oil and/or the cooling liquid on the transmission element and/or the pulleys by means of one or several feed pipes.

[0005] In the embodiments known until now, the contact surfaces of the pulley halves are finished by means of conventional polishing.

[0006] New types of transmission elements have been developed recently whereby the contact surfaces of the parts are provided with a profiling which procure a thin-film lubrication. These profilings are made such that the above-mentioned parts locally penetrate deeper in the oil film situated between the parts and the pulley halves, so that a metal-on-metal contact is obtained locally, as a result of which the risk for the transmission element to slip under a heavy load is minimized.

[0007] Further, it is known that a new transmission element must always wear in, whereby the contact surfaces of the above-mentioned parts on the one hand, and the pulley halves on the other hand act on one another and adjust to one another as a result of minor wear, after which there will be practically no wear anymore, or at least the wear which is brought about afterwards is so minor that the life of the continuous variable transmission will exceed the normal life of the motor vehicle.

[0008] In transmission units which are equipped with the above-mentioned recent types of transmission elements, it was found, however, that there is often an unstable wear-in, whereby instead of the contact sur-

faces getting adjusted to one another, these surfaces start acting on one another more and more aggressively, and the roughness on these surfaces remains or even increases. As a result, the transmission unit is strongly subject to wear, so that the aimed life and quality are not achieved.

[0009] The invention aims a transmission unit with a transmission element which makes use of the principle of thin-film lubrication, but whereby the above-mentioned disadvantages are excluded with certainty.

[0010] To this end, the invention concerns a transmission unit of the type containing a continuous variable transmission consisting of an ingoing shaft, a driven shaft, two pulleys situated on the ingoing shaft and the driven shaft respectively, and an endless transmission element provided between said pulleys, whereby the above-mentioned pulleys each consist of two pulley halves with conical contact surfaces which can be axially adjusted in relation to one another, such that the transmission ratio between the ingoing shaft and the driven shaft can be continuously altered, whereby the transmission element consists of a lubricated belt which is provided with metal parts having contact surfaces which work in conjunction with the above-mentioned conical contact surfaces of the pulley halves, and whereby the contact surfaces of the parts have a profiling, in particular a profiling procuring a thin-film lubrication, characterized in that the conical contact surfaces of the pulley halves concerned are polished.

[0011] As use is made of a combination of a profiled contact surface on the above-mentioned parts and a polished contact surface on the pulley halves, the contact surface of the pulley halves is particularly smooth, and there are no two rough surfaces acting on one another, which finally has for a result that the profiled contact surface of the above-mentioned parts will always smoothly adjust to the contact surface of the pulley halves. This guarantees a stable wear-in.

[0012] The profile of the contact surfaces of the above-mentioned parts can be of any nature whatsoever and may for example consist of a punched profile, a corrugated profile or a profile formed of local recesses which are obtained for example by sandblasting the surface concerned.

[0013] The conical contact surfaces are preferably polished with a cloth with particles or with a polishing block. In particular, they are preferably polished by means of a rotating polishing movement. Thanks to this rotating polishing movement is obtained a very smooth surface. In the case where there are nevertheless roughnesses, they do not extend in the sense of rotation of the pulleys, which has for a result that, at the time of the wear-in, the roughnesses on the contact surface of the pulley halves can never co-operate with the profiling on the contact surfaces of the above-mentioned parts, and an unstable wear-in is once more counteracted.

[0014] Naturally, the invention also concerns a pulley for realizing the above-mentioned transmission unit,

characterized in that it is provided with one or several conical contact surfaces which are polished.

[0015] The invention also concerns a method for realizing such a pulley, characterized in that, at the time of the final finishing, the conical contact surfaces are polished with a rotating polishing element.

[0016] A polishing element is hereby preferably used which has such a diameter that this polishing element covers the entire or almost entire radial length of the conical contact surface. As the entire radial length is covered at once, the creation of roughnesses is minimized.

[0017] It is also preferred that the polishing element, as it carries out a rotating movement around its own axis, is moved over the contact surface of the pulley half to be worked, such according to a circular path in relation to said pulley half.

[0018] According to a practical embodiment, the pulley half to be worked is driven in a rotating manner, and the rotating polishing element is represented to the rotating contact surface in a fixed place.

[0019] In order to better explain the characteristics of the invention, the following preferred embodiments are described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 schematically represents a transmission unit;

figure 2 represents a section according to line II-II in figure 1 in a highly schematic manner, in which the two farthest positions of the transmission element are represented;

figure 3 represents a section to a larger scale on the place which is indicated by arrow F3 in figure 1, for an embodiment according to the invention;

figure 4 represents a variant of the part which is represented in figure 3;

figure 5 schematically represents the method according to the invention.

[0020] As represented in the figures 1 and 2, the invention concerns a transmission unit 1 containing a continuous variable transmission 2, consisting of an ingoing shaft 3, a driven shaft 4, two pulleys 5-6 situated on the ingoing shaft 3 and the driven shaft 4 respectively, and an endless transmission element 7 provided between said pulleys 5-6. The pulleys 5-6 each consist of two pulley halves 8-9 and 10-11 with conical contact surfaces 12. The pulley halves 8-9, 10-11 respectively can be axially adjusted in relation to one another, such that the transmission ratio between the ingoing shaft 3 and the driven shaft 4 can be continuously altered.

[0021] The above-mentioned transmission element 7 consists of a lubricated belt which is provided with metal parts 13 having contact surfaces 14 which work in conjunction with the above-mentioned conical contact surfaces 12. The lubrication can be carried out in any

way whatsoever. In the given example, this is done by means of a belt lubricating pipe 15 via which a number of squirts of oil and/or cooling liquid 16 are squirted on the transmission element 7 and/or on the pulleys 5-6.

[0022] Also the metal parts 13 can be linked to one another in any way whatsoever. Examples thereof are sufficiently known from the state of the art and consequently are not further described here.

[0023] As mentioned in the introduction, the invention specifically concerns embodiments whereby the contact surfaces 14 have a profiling which procures a thin-film lubrication. An example of such a profiling 17 is represented in figure 3. Use is hereby made of a corrugated profile, preferably obtained by means of punching. It should be noted that in reality, the roughnesses of this profiling 17 are very small. In a practical embodiment, the ribs 18 will for example have top sides with a width of a few hundreds of a millimeter, whereas they have a height of for example 0.03 mm.

[0024] By a thin-film lubrication is meant that the oil film 19 which is present on certain places on the contact surfaces 12 is entirely or almost entirely displaced locally, so that a metal-on-metal contact is obtained and the risk of slipping is minimized. Thanks to the use of a profiling 17 as mentioned above, such a thin-film lubrication is obtained, as the protruding parts of the profiling 17 can easily penetrate in the oil film 19.

[0025] The invention is special in that a combination is made of the use of contact surfaces 14 which are provided with such a profiling 17 on the one hand, and the use of contact surfaces 12 which are polished on the other hand. Thus, as explained in the introduction, it is excluded that two profilings, namely the above-mentioned wanted profiling 17 on the one hand, and a profiling due to a too rough finishing of the contact surfaces 12 on the other hand, start acting on one another, as a result of which the wanted profiling 17 would disappear in no time due to wear.

[0026] Thanks to the present invention, there will be only a limited wear on the ribs 18 as the transmission unit wears in, such that a stable profile finally remains, for example having a rib height of 0.01 mm, such for the entire life of the continuous variable transmission 2.

[0027] As mentioned in the introduction, the profiling 17 can be of any nature whatsoever. As an example is given a profiling 17 with local recesses 20 in figure 4, resulting from the sandblasting of the contact surface 14, such in combination with a contact surface 12 which is polished in compliance with the invention.

[0028] The contact surfaces 12 are preferably polished in a manner as represented in figure 5.

[0029] The conical contact surfaces 12 are hereby treated with a rotating polishing element 21, in particular a polishing block. This is represented in figure 5 for one pulley half, but it is clear that the other pulley halves can be treated in a similar manner.

[0030] A polishing element 21 is preferably used hereby, having such a diameter D that this polishing ele-

ment 21 covers the entire or almost the entire radial length of the conical contact surface 12, whereby the distance indicated by 'R' in figure 5 is meant by this radial length.

[0031] As represented in figure 5, the polishing element 21 is moved over the contact surface 12 of the pulley half to be treated according to a circular path in relation to this pulley half, while carrying out a rotating movement around its own axis 22, which is realized by driving the pulley half to be treated around its axis 23 in a rotating manner, and by representing the rotating polishing element 21 to the rotating contact surface 12 in a fixed place.

[0032] It should be noted that by the above-mentioned term 'oil' is implied any type of lubricant and/or cooling medium. By 'metal' parts are understood parts which are exclusively made of metal, as well as parts made of hard materials having a hardness which can be compared to that of the metal parts, as well as parts made of other materials, but whose contact surfaces 12 are made of metal or a material which is comparable as far as hardness is concerned.

[0033] Although the contact surface 12 of every pulley half 8-9-10-11 is preferably polished, it is clear that the invention also concerns embodiments whereby only one or a restricted number of the contact surfaces 12 are polished.

[0034] The present invention is by no means limited to the above-described embodiments represented in the accompanying drawings; on the contrary, such a transmission unit, the pulleys used thereby and the above-mentioned method can be made in all sorts of variants while still remaining within the scope of the invention.

Claims

1. Transmission unit for motor vehicles of the type containing a continuous variable transmission (2) consisting of an ingoing shaft (3), a driven shaft (4), two pulleys (5-6) situated on the ingoing shaft (3) and the driven shaft (4) respectively, and an endless transmission element (7) provided between said pulleys (5-6), whereby the above-mentioned pulleys (5-6) each consist of two pulley halves (8-9, 10-11) with conical contact surfaces (12) which can be axially adjusted in relation to one another, such that the transmission ratio between the ingoing shaft (3) and the driven shaft (4) can be continuously altered, whereby the transmission element (7) consists of a lubricated belt which is provided with metal parts (13) having contact surfaces (14) which work in conjunction with the above-mentioned conical contact surfaces (12) of the pulley halves (8-9, 10-11), and whereby the contact surfaces (14) of the parts (13) have a profiling (17), in particular a profiling (17) procuring a thin-film lubrication, characterized in that the conical contact sur-

faces (12) of the pulley halves (8-9, 10-11) concerned are polished.

2. Transmission unit according to claim 1, characterized in that the contact surfaces (14) of the metal parts (13) are provided with a punched profile.
3. Transmission unit according to claim 1 or 2, characterized in that the contact surfaces (14) of the metal parts (13) have a corrugated structure.
4. Transmission unit according to claim 1, characterized in that the contact surfaces (14) of the metal parts (13) have a profile with local recesses (20).
5. Transmission unit according to claim 4, characterized in that the contact surfaces (14) are sand-blasted.
6. Transmission unit according to any of the preceding claims, characterized in that the conical contact surfaces (12) are polished with a cloth with particles or with a polishing element (21) in the shape of a polishing block.
7. Transmission unit according to any of the preceding claims, characterized in that the conical contact surfaces (12) are polished by means of a rotating polishing movement.
8. Pulley for a transmission unit as described in claims 1 to 7, characterized in that it is provided with conical contact surfaces (12) which are polished.
9. Method for producing a pulley according to claim 8, characterized in that the conical contact surfaces (12) are polished by means of a rotating polishing element (21).
10. Method according to claim 9, characterized in that a polishing element (21) is used having a diameter (D), and in that this polishing element (21) covers the entire or practically the entire radial length (R) of the conical contact surface (12).
11. Method according to claim 9 or 10, characterized in that the polishing element (21) is moved over the contact surface (12) of the pulley half (8-9-10-11) to be treated according to a circular path in relation to this pulley half, while carrying out a rotating movement around its own axis (22).
12. Method according to claim 11, characterized in that the pulley half (8-9-10-11) to be treated is driven in a rotating manner, and in that the rotating polishing element (21) is represented to the rotating contact surface (12) in a fixed place.

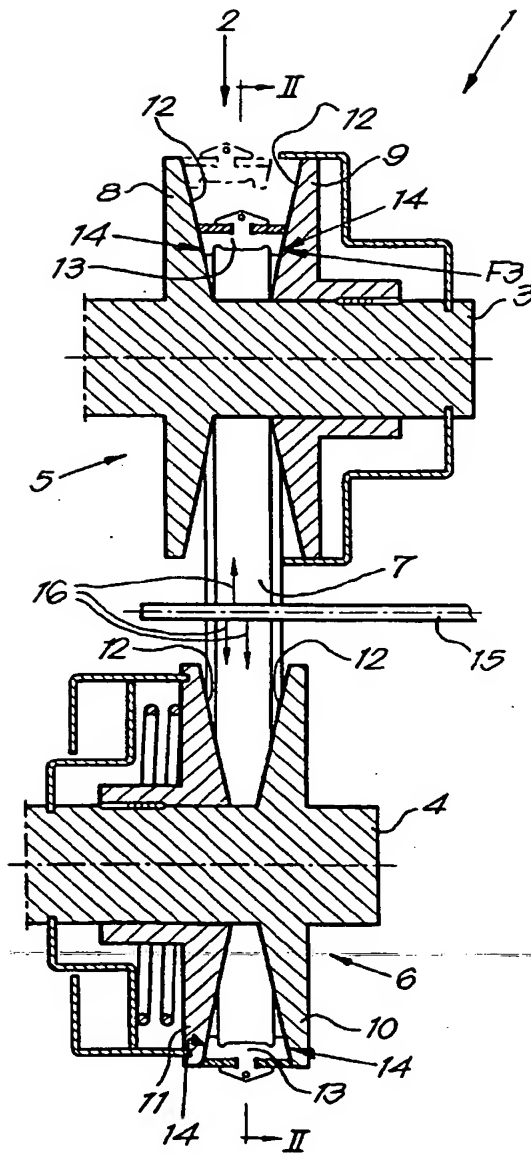


Fig. 1

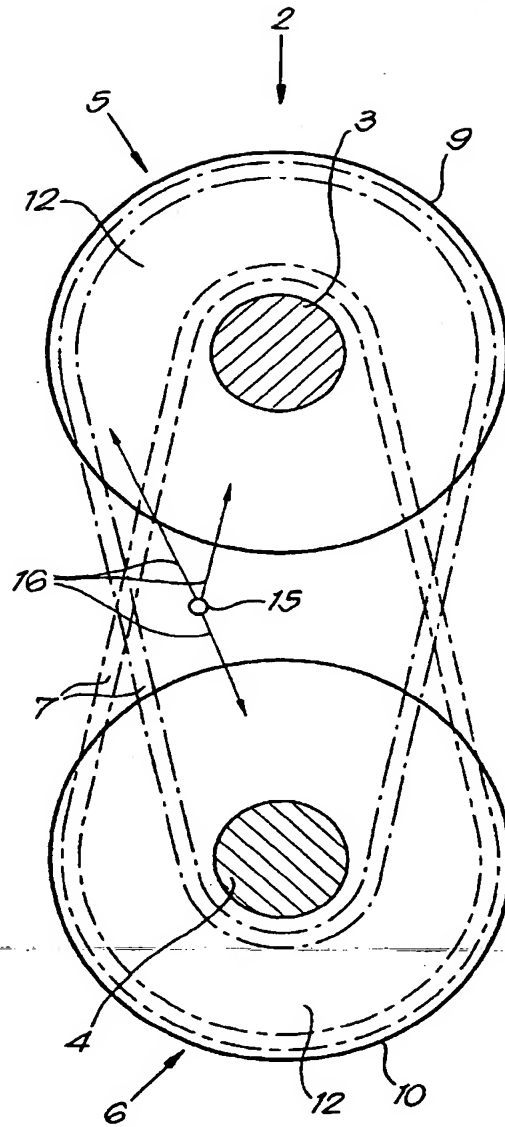


Fig. 2

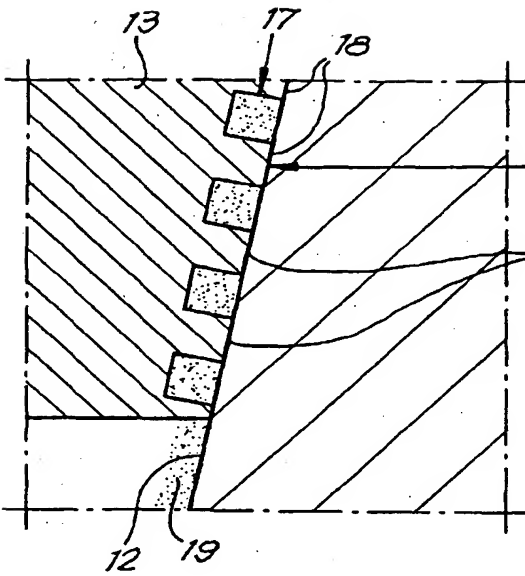


Fig. 3

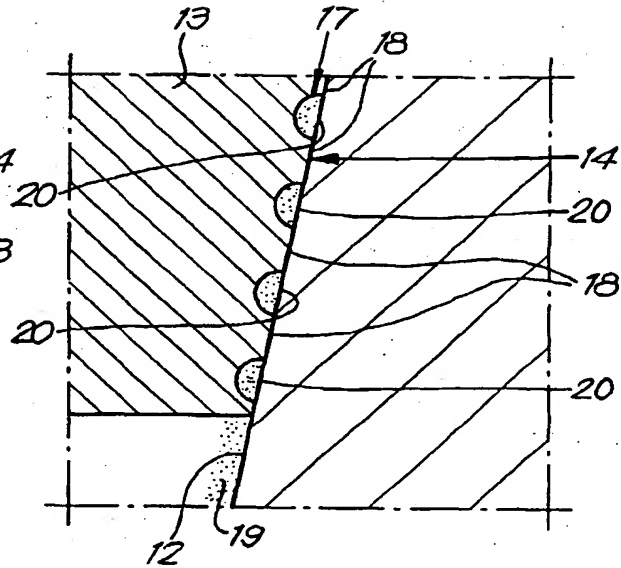


Fig. 4

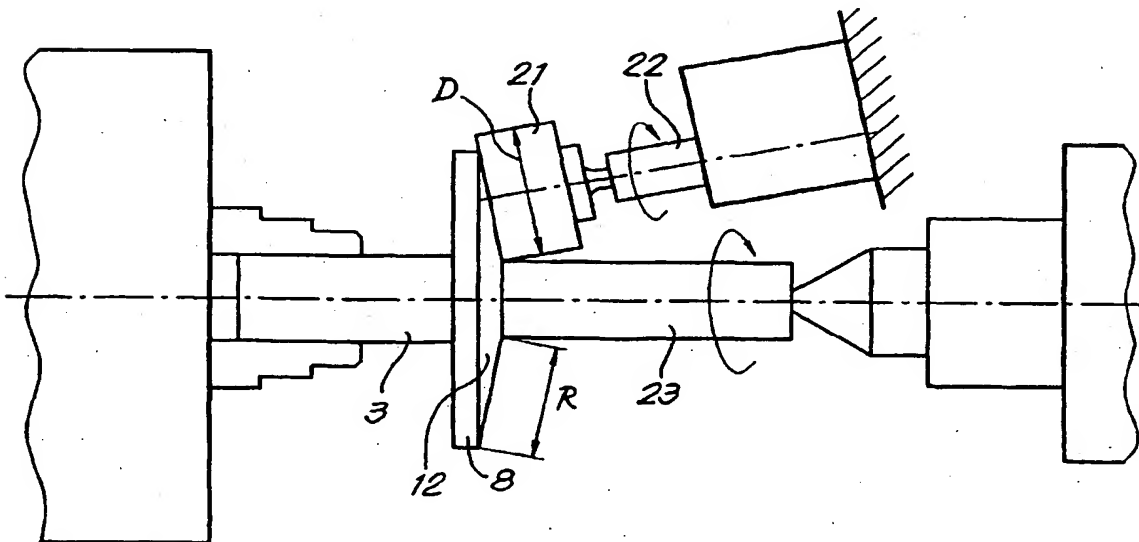


Fig. 5



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 0530

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 381 258 A (VAN DOORNE'S) 8 August 1990 (1990-08-08) * abstract; figures 1-5 *	1,4,8,9	F16H55/56 F16H9/24
A	GB 1 549 403 A (VAN DOORNE'S) 8 August 1979 (1979-08-08) * the whole document *	1,4,8,9	
A	US 4 794 741 A (VAN DOORNE'S) 3 January 1989 (1989-01-03) * column 3, line 23 - line 27; figure 4 *	1,5,8,9	
D,A	EP 0 574 085 A (VCST) 15 December 1993 (1993-12-15) * abstract; figure 1 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F16H
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 5 June 2000	Examiner Flores, E
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date O : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03/02 (P4/C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 20 0530

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

05-06-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0381258 A	08-08-1990	NL 8900266 A	03-09-1990
		DE 69006520 D	24-03-1994
		DE 69006520 T	01-06-1994
		JP 2236045 A	18-09-1990
		US 5011461 A	30-04-1991
GB 1549403 A	08-08-1979	BE 847135 A	08-04-1977
		IE 43741 B	20-05-1981
		IT 1071506 B	10-04-1985
US 4794741 A	03-01-1989	NL 8501087 A	03-11-1986
		DE 3661767 D	16-02-1989
		EP 0200246 A	05-11-1986
		JP 1754732 C	23-04-1993
		JP 4040155 B	01-07-1992
		JP 61236473 A	21-10-1986
EP 0574085 A	15-12-1993	BE 1005995 A	12-04-1994
		AT 143109 T	15-10-1996
		DE 69304803 D	24-10-1996
		DE 69304803 T	03-04-1997
		JP 6050400 A	22-02-1994

EPO FORM P439

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82